WE CLAIM:

1. An air quality system for removing a pollutant from an air stream, and for providing cleansed air to an interior air space, said air quality system comprising:

at least one air cleaner unit in communication with said interior air space,

wherein said at least one air cleaner unit provides only a single flow path for said air stream,

wherein said at least one air cleaner unit comprises a first photocatalytic oxidation unit and a first adsorbent unit, and

wherein said first photocatalytic oxidation unit is located upstream or downstream from said first adsorbent unit.

2. The air quality system of claim 1, wherein said first photocatalytic oxidation unit is physically separated from said first adsorbent unit.

3. The air quality system of claim 1, wherein said first photocatalytic oxidation unit is located downstream from said first adsorbent unit.

4. The air quality system of claim 3, wherein:

said first adsorbent unit is adapted to reversibly adsorb said pollutant from said air stream at a first concentration of said pollutant, and

said first adsorbent unit is further adapted to desorb said pollutant into said air stream at a second concentration of said pollutant.

5. The air quality system of claim 1, wherein:

said at least one air cleaner unit further comprises a second adsorbent unit,

said first photocatalytic oxidation unit is located downstream from

said first adsorbent unit, and

said second adsorbent unit is located downstream from said first photocatalytic oxidation unit.

6. The air quality system of claim 5, wherein:

said first adsorbent unit is adapted to reversibly adsorb said pollutant from said air stream at a first concentration of said pollutant,

said first adsorbent unit is further adapted to desorb said pollutant into said air stream at a second concentration of said pollutant, and

said second adsorbent unit is adapted to irreversibly adsorb said pollutant from said air stream.

7. The air quality system of claim 6, wherein:

said first adsorbent unit includes a first adsorbent material having a first isotherm curve for said pollutant,

said second adsorbent unit includes a second adsorbent material having a second isotherm curve for said pollutant, and

said second isotherm curve is steeper than said first isotherm curve.

8. The air quality system of claim 5, wherein:

said at least one air cleaner unit further comprises a second photocatalytic oxidation unit, and

said second photocatalytic oxidation unit is located downstream from said second adsorbent unit.

9. The air quality system of claim 8, wherein said first photocatalytic oxidation unit comprises at least one photocatalytic panel, wherein said photocatalytic panel comprises a photocatalytic support, and wherein said photocatalytic panel comprises expanded aluminum.

10. The air quality system of claim 1, wherein:

said first adsorbent unit includes a first adsorbent material, said first adsorbent material having micropores in the range of from about 5 to 10 Å in diameter.

11. The air quality system of claim 10, wherein:

at least about 30% of said micropores have a diameter in the range of from about 5 to 10 Å.

12. The air quality system of claim 10, wherein:

said first adsorbent material comprises an activated carbon fabric.

13. The air quality system of claim 1, wherein said interior air space is within an aircraft.

14. The air quality system of claim 1, wherein said interior air space includes a cabin of an aircraft, and said air quality system further comprises:

at least one air intake unit; and

a mix manifold located downstream from said at least one air intake unit,

wherein said at least one air cleaner unit comprises a first battery of air cleaner units, and wherein said first battery of air cleaner units is located between said mix manifold and said cabin.

15. The air quality system of claim 1, wherein said at least one air cleaner unit is adapted for passage of a unidirectional air stream therethrough.

16. The air quality system of claim 1, wherein said at least one air cleaner unit is adapted for continuously providing a stream of cleansed air to a

location downstream from said at least one air cleaner unit.

17. The air quality system of claim 1, further comprising a particulate filter upstream from said at least one photocatalytic oxidation unit and said at least one adsorbent unit.

18. The air quality system of claim 1, wherein said at least one air cleaner unit is adapted for operation at a constant temperature.

19. The air quality system of claim 1, wherein said at least one air cleaner unit is adapted for operation at ambient temperature.

20. An air quality system for an interior air space of an aircraft, said interior air space including a cabin, a lower plenum, and an upper plenum, and said air quality system comprising:

a mix manifold for distributing air to said interior air space;

a lower recirculation system in communication with said mix manifold;

an upper recirculation system in communication with said lower recirculation system;

at least one air intake unit in communication with said mix manifold; and

a plurality of air cleaner units in communication with said interior air space, each of said plurality of air cleaner units comprising at least one photocatalytic oxidation unit and at least one adsorbent unit, said at least one photocatalytic oxidation unit located upstream or downstream from said at least one adsorbent unit.

21. The air quality system of claim 20, wherein:

said plurality of air cleaner units comprise a first battery of air cleaner units coupled to said lower recirculation system, and

said first battery of air cleaner units adapted for receiving air directly from said lower plenum.

22. The air quality system of claim 20, wherein:

said interior air space further includes a flight deck, and

said plurality of air cleaner units comprise at least one air cleaner unit located between said air intake unit and said flight deck.

23. The air quality system of claim 20, wherein:

said upper recirculation system includes a plurality of cabin supply lines, and

said plurality of air cleaner units comprise a second battery of air cleaner units, and

said second battery of air cleaner units is coupled to said plurality of cabin supply lines.

24. The air quality system of claim 23, wherein said second battery of air cleaner units are adapted for receiving air directly from said upper plenum.

25. The air quality system of claim 20, wherein:

said air intake unit is located upstream from an ECS of said aircraft, and

said plurality of air cleaner units are located downstream from said ECS.

26. A vehicle, comprising:

an air quality system including at least one air cleaner unit and an interior air space,

said at least one air cleaner unit in communication with said interior air space,

said at least one air cleaner unit comprising a first photocatalytic oxidation unit, a first adsorbent unit, and a second adsorbent unit,

said first photocatalytic oxidation unit is located downstream from said first adsorbent unit, and

said second adsorbent unit located downstream from said first photocatalytic oxidation unit.

27. The vehicle of claim 26, wherein said at least one air cleaner unit further comprises a second photocatalytic oxidation unit, and said second photocatalytic oxidation unit is located downstream from said second adsorbent unit.

28. The vehicle of claim 26, wherein:

said first photocatalytic oxidation unit and said second photocatalytic oxidation unit each comprise at least one photocatalytic panel and at least one UV source, and

said at least one panel comprising a photocatalytic support and a photocatalytic agent disposed on said photocatalytic support.

29. The vehicle of claim 26, wherein:

said first adsorbent unit includes a first adsorbent material, and

said first adsorbent material comprises an activated carbon fabric having micropores in the range of from about 5 to 10 Å in diameter.

30. The vehicle of claim 26, wherein said interior air space includes an aircraft cabin.

31. The vehicle of claim 26, wherein:

said interior air space includes a flight deck,

said vehicle includes an air intake unit in communication with said flight deck, and

said at least one air cleaner unit is arranged between said air intake unit and said flight deck.

32. The vehicle of claim 26, further comprising an ECS, and wherein said at least one air cleaner unit is located downstream from said ECS.

33. An air cleaner unit for removing a pollutant from an air stream, comprising:

a housing;

a first photocatalytic oxidation unit arranged within said housing; and

a first adsorbent unit arranged parallel to said first photocatalytic oxidation unit in said housing, said housing defining only a single flow path for said air stream.

34. The air cleaner unit of claim 33, wherein:

said first photocatalytic oxidation unit is located upstream or downstream from said first adsorbent unit, and

said air cleaner unit is adapted for unidirectional passage of said air stream through said first photocatalytic oxidation unit and said first adsorbent unit.

35. The air cleaner unit of claim 33, further comprising a particulate filter located upstream from said first photocatalytic oxidation unit and said first adsorbent unit.

36. The air cleaner unit of claim 33, wherein:

said first adsorbent unit includes a first adsorbent material, said first adsorbent material having micropores therein, and

wherein at least about 30% of said micropores have a diameter in the range of from about 5 to 10 Å.

37. The air cleaner unit of claim 33, wherein:

said first adsorbent material comprises an activated carbon fabric.

38. The air cleaner unit of claim 33, further comprising a second adsorbent unit, wherein said first photocatalytic oxidation unit is located downstream from said first adsorbent unit, and said second adsorbent unit is located downstream from said first photocatalytic oxidation unit.

39. The air cleaner unit of claim 38, wherein:

said first adsorbent unit includes a first adsorbent material having a first isotherm curve for adsorption of said pollutant,

said second adsorbent unit includes a second adsorbent material having a second isotherm curve for adsorption of said pollutant, and

said second isotherm curve is steeper than said first isotherm curve.

40. The air cleaner unit of claim 33, wherein:

said first photocatalytic oxidation unit comprises at least one photocatalytic panel and at least one UV source, and

said photocatalytic panel comprises a photocatalytic support and a photocatalytic agent on said metal support.

41. The air cleaner unit of claim 33, wherein:

said first photocatalytic oxidation unit comprises a plurality of photocatalytic panels and a plurality of UV sources, and

said plurality of photocatalytic panels and said plurality of UV sources are arranged linearly and parallel to each other, with each of said plurality of UV sources alternating with each of said plurality of photocatalytic panels.

42. The air cleaner unit of claim 33, wherein said first adsorbent unit comprises an apparatus selected from the group consisting of packed bed of carbon, a carbon fabric, a solid carbon monolith, and a carbon-coated monolith.

43. An air cleaner unit for removing a pollutant from an air stream, comprising:

a first adsorbent unit;

a first photocatalytic oxidation unit located downstream from said first adsorbent unit;

a second adsorbent unit located downstream from said first photocatalytic oxidation unit; and

a housing,

said first adsorbent unit, said first photocatalytic oxidation unit, and said second adsorbent unit arranged parallel to each other within said housing,

said housing defining a single flow path for said air stream,

said first adsorbent unit, said first photocatalytic oxidation unit, and

said second adsorbent unit arranged orthogonal to said air stream,

wherein said first photocatalytic oxidation unit comprises a plurality of photocatalytic panels, each of said plurality of photocatalytic panels comprises a photocatalytic support and a photocatalytic agent disposed on said photocatalytic support.

44. The air cleaner unit of claim 43, wherein:

said first adsorbent unit includes a first adsorbent material having a first isotherm curve for adsorption of said pollutant, and

said second adsorbent unit includes a second adsorbent material having a second isotherm curve for adsorption of said pollutant, and

wherein said second isotherm curve is steeper than said first isotherm curve.

45. A method for removing a pollutant from an air stream, the method comprising:

a) providing at least one air cleaner unit, said air cleaner unit comprising a first adsorbent unit, a first photocatalytic oxidation unit, and a second adsorbent unit, wherein said first photocatalytic oxidation unit is located downstream from said first adsorbent unit and said second adsorbent unit is located downstream from said first photocatalytic oxidation unit;

b) passing said air stream through said first adsorbent unit, said first adsorbent unit including a first adsorbent material having a first isotherm curve for adsorption of said pollutant;

c) thereafter, passing said air stream through said first photocatalytic oxidation unit; and

d) thereafter, passing said air stream through said second adsorbent unit, said second adsorbent unit including a second adsorbent material having a second isotherm curve for adsorption of said pollutant.

46. The method of claim 45, wherein said second isotherm curve is steeper than said first isotherm curve.

47. The method of claim 45, further comprising:

e) after said step d), passing said air stream through a second photocatalytic oxidation unit, said second photocatalytic oxidation unit being located downstream from said second adsorbent unit.

48. The method of claim 45, further comprising:

f) prior to said step b), passing said air stream through a HEPA filter, said HEPA filter being located upstream from said first adsorbent unit.

49. The method of claim 45, wherein said step a) comprises providing a plurality of air cleaner units, and wherein said air stream emanates from an ECS of an aircraft.

50. The method of claim 49, wherein at least one of said plurality of air cleaner units is located between an air intake unit and a mix manifold of the aircraft.

51. The method of claim 49, wherein said plurality of air cleaner units comprise a first battery of air cleaner units coupled to a lower recirculation system of said aircraft, and a second battery of air cleaner units coupled to an upper recirculation system of said aircraft.

52. The method of claim 45, wherein said first adsorbent material comprises an activated carbon fabric, and wherein said step b) comprises passing said air stream through said activated carbon fabric.

53. The method of claim 45, wherein said first adsorbent material includes micropores therein, said micropores having a diameter in the range of from about 5 to 10 Å.

54. The method of claim 45, wherein said first and second adsorbent units are maintained at a temperature in the range of from about 15 to 30°C.

55. The method of claim 45, wherein said pollutant comprises a VOC, a SVOC, a microorganism, or a virus.

56. A method for making an air cleaner unit for removing pollutants from an air stream, the method comprising:

a) providing a first photocatalytic oxidation unit;

b) providing a first adsorbent unit;

c) providing a housing for accommodating said first photocatalytic oxidation unit and said first adsorbent unit;

d) arranging said first adsorbent unit in said housing; and

e) arranging said first photocatalytic oxidation unit in said housing such that said first photocatalytic oxidation unit is located downstream or upstream from said first adsorbent unit, wherein said housing is adapted for providing a single flow path for passage of said air stream through said first photocatalytic oxidation unit and said first adsorbent unit.

57. The method of claim 56, wherein said first adsorbent material comprises an activated carbon fabric having micropores in the range of from about 5 to 10 Å in diameter.

58. The method of claim 56, wherein said step e) comprises arranging said first photocatalytic oxidation unit in said housing such that said first photocatalytic oxidation unit is located downstream from said first adsorbent unit.

59. The method of claim 56, further comprising:

f) providing a second adsorbent unit; and

g) arranging said second adsorbent unit in said housing such that said second adsorbent unit is located downstream from said first photocatalytic oxidation unit.

60. The method of claim 59, further comprising:

h) providing a second photocatalytic oxidation unit; and

i) arranging said second photocatalytic oxidation unit in said housing such that said second photocatalytic oxidation unit is located downstream from said second adsorbent unit.

61. The method of claim 56, further comprising:

j) arranging a particulate filter upstream from said first photocatalytic oxidation unit and from said first adsorbent unit.

62. The method of claim 56, wherein said housing comprises a duct of an air recirculation system of an aircraft.

63. The method of claim 56, wherein said housing is coupled to a cabin supply line of said aircraft.